March 20, 1967

Memorandum

Re: Head Snap Phenomenon and Zapruder Film Frame Sequence

Consider the sequence of film frames 310 through 323. In frame 312, President Kennedy has not yet been struck in the head by a bullet. In frame 313, he has. Therefore, the impact of the bullet occurs at some instant between frame 312 and frame 313.

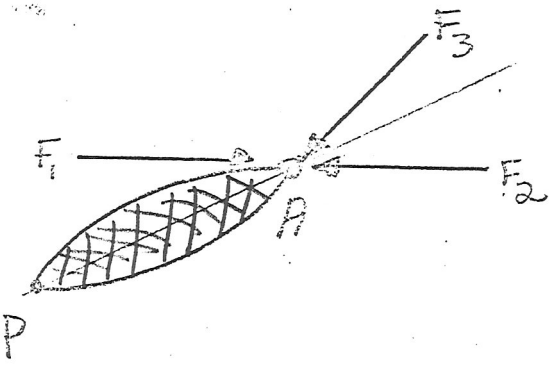
To analyze the motion of the head and torso, we must realize that the head can pivot with respect to the torso at the neck. Likewise, the whole torso pivots about the hip.

Although the torso actually pivots about the hip, for all practical purposes its motion appears on the film as translational motion: "backwards" vs. "forwards" rather than "clockwise" vs. "counter-clockwise". The same cannot, however, be said for the motion of the head about the neck pivot. The head's motion with respect to the torso is strictly rotational in nature. The lever arm from the right temporal area to the neck pivot is only a few inches, whereas the distance from the right temporal area to the hip pivot is almost 10 times as much.

The momentum transferred to the head-and-torso must simultaneously obey the conservation of linear momentum and the conservation of angular momentum. For our purposes, we merely note that the observed motion resulting from a bullet strike to the right forehead or temporal area will be some combination of two distinct motions:

1) rotational motion imparted to the head, with respect to the neck as a pivot

2) translational motion imparted to the whole head-and-torso. (Actually, the second would be rotational motion about the hip pivot).



IN ANALOGOUS ANALYSIS TO BE CONSIDERED OF ACTUAL JEK HEAD MOTION, (STARTING ON PAGE 4, bottom) SHADED OBJECT CORRESPONDS TO JEK HEAD, PIVOTED ABOUT THE NECK PIVOT "P." POINT "A" IS THE APPLICATION point OF THE IMPACTING FORCE)

negative "−" ⟷ positive "+"

Fig I

Diagram illustration an object which can rotate about P and which is "pulsed" by a force at point A.

In addition, the object is not fixed so rigidly that it cannot translate.

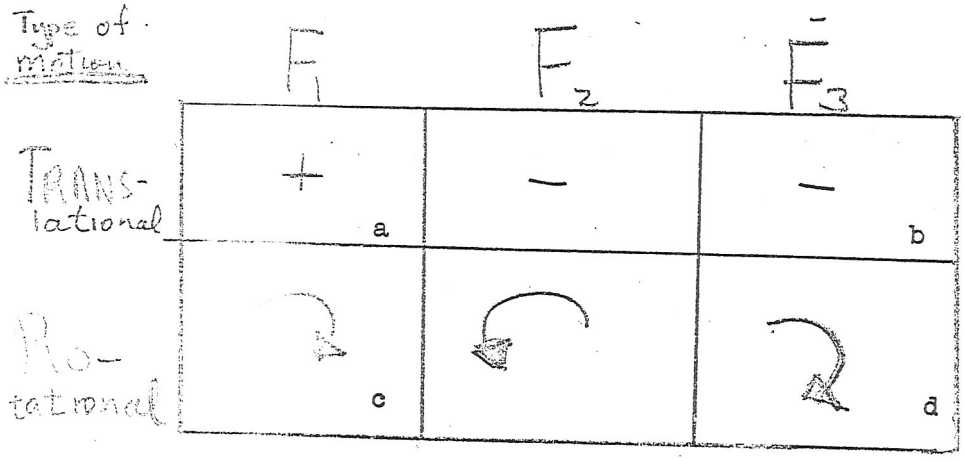


Fig II

A matrix which shows the different types of translation-and-rotation combinations which result when three distinct types of forces are used to "pulse" the object, as shown in Figure I. "plus" and "minus" are defined in figure I.

Important result: F_1 and F_3 produce the same type of rotation, (see boxes c and d, despite the fact that they produce opposite types of translation (see boxes a and b)

Now consider Figure I. An analysis of this hypothetical situation is crucial to an understanding of the film frame sequence 312 through 323. [This is discussed, starting on the bottom of page 4, using the general principles developed in the following analogous — but more abstract — discussion. See Fig I for how this model is used in that discussion]

Figure I shows a body which is pivoted at P. A force of great magnitude and very short duration will be applied at point A. Finally, the object is not solidly anchored at its pivot point, P_0 It can translate. The resultant motion will be some combination of rotation and translation. Let us see what happens when three different types of forces are applied.

In each case, we want to know two things.

1) Will the rotational motion be clockwise or counterclockwise?

2) Will the translational motion be positive (forwards) or negative (backwards)? (We ignore vertical translation for the purpose of this analysis.)

CASE 1

the force: F_1 is applied from the rear, as shown in figure 1.

The translation motion will be forward. (Linear momentum conservation law)

The rotational motion will be clockwise. (Angular momentum conservation law)

The result will be some combination of the above two types of motions.

CASE 2

the force: F_2 is applied (see diagram) from the front.

The translational motion will be rearward. (Linear momentum...)

The rotational motion will be counterclockwise. (Angular momentum...)

The resultant motion will be some combination of these two types of motions.

CASE 3

the force: F_3 is applied (see diagram), also from the front.

It is applied at an angle that is steeper than the line drawn from the pivot to the point of application, A.

This will cause a different type of rotation to take place, but will not change the nature of the translational motion (from case 2).

The translation will be rearward (as in the previous case) because the force was applied from the front, and linear momentum must be conserved.

The rotational motion, however, will be clockwise.

It is absolutely crucial to notice that this clockwise rotational motion (of the JFK head, for example, about the neck pivot) results from either

a) a low angle force applied from the rear (F_1)

b) a high angle force applied from the front. (F_3)

It is a fact that if one only had data regarding the rotational component of motion, one would NOT be able to tell whether that force was applied from the rear or applied from the front. F_3 is applied from the front. F_1 is applied from the rear. Yet both F_3 and F_1 cause clockwise rotational motion to take place.

Figure II is a matrix which sums up these general results. The only unambiguous rotational motion is the counterclockwise one (associated with F_2). That is, if one only had data regarding the rotational motion, and if the rotation is clockwise, then one needs information about translation in order to know whether the force was applied from the rear (low angle) or from the front (high angle). But if one's rotational data indicates "counterclockwise", then it is unambiguously and uniquely determined that the force was applied from the front.

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The head of President Kennedy pivots about his neck. Therefore, let us apply the information developed in the preceding analysis to the Zapruder film frame sequence.

For the purposes of this discussion, assume JFK was hit by only one bullet in the head during this sequence of frames. Two types of motion are possible.

low angle shot from the front

This corresponds to Case 2. The head and torso are driven left and rear.

The head pivots on the neck in such a way as to cause the chin to be thrust UP and AWAY from the necktie knot at the moment of impact.

high angle shot from the front

This corresponds to case 3. The head and torso are driven left and rear,

BUT

The head pivots on the neck in such a way as to cause the chin to be thrust violently downwards and towards the chest area just to the left of the necktie knot at the moment of impact.

If it could be established that only one bullet hit the head, it would be very easy to use these two entirely different types of rotational head motions to distinguish between a low angle forward shot and a high angle forward shot.

The Zapruder film clearly shows the second type of motion. Because it can not be definitely established that only one bullet hit the head, another hypothesis, the double-head-hit, has been posited as an alternate explanation for the observed motion.

HYPOTHESIS TESTING USING THE FILM FRAME SEQUENCE 312-323

The head of President Kennedy pivots about his neck. Therefore, it is not possible to reduce the interpretation of the film sequence after 312 by ignoring this factor, and reduce everything to the question of whether the head is moving "forward" or "backwards" between frame 312 and frame 313. In fact, it is precisely the principles developed in the preceding discussion that are going to govern the motion.

It cannot be emphasized too strongly that if one restricts oneself to the observation of the two film frames 312-313 only, one has no way to distinguish as to whether the initial observed motion is the (forward) translational and/or (clockwise) rotational motion of a low angle rearward shot, or the (clockwise) rotational motion which would just precede the (rearward) translational motion from a high angle forward shot.

In much simpler terms, it is logically fallacious and physically erroneous to interpret these two film frames separately, out of context of the rest of the sequence. (To do so is to, in effect, be attempting to tell which force is being applied in the previous hypothetical example from the rotational motion only. As was discussed previously, this only leads to an unambiguous result if the observed rotational motion is COUNTERclockwise.)

Proponents of the lone-assassin-firing-from-the-rear theory insist on doing just this, and then arguing that the 312-313 motion "proves" that the shot was fired from the rear because the head moves "forward".

What about the rest of the sequence, when the head moves rearward? They argue that neuromuscular forces must have come into play.

About Outside Forces

It must be understood that if unpredictable forces of any type are present, then physics can not be applied to this sequence. It is self serving and unfair to use the motion of two film frames that support a rearward-firing assassin and to dismiss the rest of the sequence by invoking outside forces.

It is possible that outside forces come into play <u>after</u> 313, that for some reason are not there between the instant of impact (somewhere between 312 and 313) and 313; but there is no evidence whatsoever to support this. It is the sort of improbable possibility whose existance must be admitted only because there is no way to disprove it with certainty.

The neurosurgeons I have talked with say that instant lampness would be the result of Kennedy's head being damaged as it was. In that case, physics governs the entire sequence.

Therefore, the <u>entire</u> sequence of the Zapruder film should be used, in the light of physics, to test various hypothesis about bullet strikes. Woe to the MD or PhD physicist who is going to split hairs and say: "in this film frame there is <u>no</u> neuromuscular reaction, but in the next one there <u>is</u>; therefore, there is only one assassin firing from the rear".

When the entire sequence is considered, there is only one hypothesis that explains the motion IF ONLY ONE BULLET STRUCK THE HEAD. That is that the bullet came from the <u>right</u>, from the <u>front</u>, and from an angle that is <u>greater</u> than that of a line drawn between the neck pivot and the point of application of the force (in the right temporal area). Given the decline of the street, and the fact that JFK's head was slumped slightly forward, Dr. Riddle and I estimated that this angle was approximately 25 degrees to the horizontal. That is the

basis for the quote in footnote ten of Part II of the Ramparts 3 assassin story. The text read:

" 3. The initial motion of his head is downward in frames 312-313.[10]"

Footnote 10 reads: "The initial motion of the head (frames 312-313) is consistent with a bullet fired from an elevation of about 25 degrees or more from the direction we have postulated, since this would cause a turning motion about the neck in the direction observed."

Because far too much theory would be involved than space existed to correctly explain, the motion was simply evaluated as "downward" and the footnote was provided.

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It has already been argued that if only frames 312 - 313 are considered (and if NO medical data is invoked, and if it is assumed that only one bullet struck the head) then it is impossible to tell whether the 312-313 motion is the result of a low angle rearward shot or a high angle forward shot.

When, however, the entire sequence is considered (with the same aforementioned restrictions) it must be a high angle forward shot that hit JFK at 313.

Now suppose we admit the possibility of TWO bullet strikes (but still do not invoke any medical data.)

Two bullet strikes within one or two-eighteenth's of a second are highly improbable. It is, however, a possibility.

If it did occur, with the rear one coming first, a possible explanation for the resultant motion would then be as follows:

1) The first bullet strikes the head between 312 and 313 from the rear. This causes the motion observed between these two film frames.

2) The second bullet strikes the head between 313 and 314, and this causes the rest of the motion.

Besides the fact that this is a highly unlikely occurrance, it must also be understood that the velocity and/or mass of the forward striking bullet would have to be much greater than the rearward striking bullet for the resultant motion to be violently backwards and leftwards, despite the fact that a bullet had just impacted from the rear.

Other Factors and the Film Frame Sequence

Four distinct outside factors can be introduced (and interpreted differently by different people) in an attempt to decide which hypothesis explains the motion---the double-head-hit or the high angle forward shot.

These factors are:

1) The wounds of the President's head as determined from medical testimony at Parkland Hospital and/or at Bethesda.

2) The wounds of the head from information in the Zapruder frames

3) The blob of red that appears in frame 313

4) Photographic data concerning the location of shooters on the Knoll.

I will give my views on each.

1) The wounds of the head.

The Parkland description of the head wounds is totally inconsistent with frontal exit. The doctors there observed the wounds of exit to be at the rear of the President's head. It is quite apparent that the bullet exited at the rear of the head, if one were to go by this testimony only.

Two distinct things were not observed at Parkland:

a) Frontal exit
b) Rearward entry

It is possible that the doctors at Parkland missed a rear entrance wound on the head. This is generally conceded. For example, no Parkland doctor testifies to right temporal entrance wounds. But at least there is <u>some</u> indication from the record that there was such a wound. (See Hurchel Jacks; Seth Kantor's notes etc.)

I consider the entire Bethesda autopsy result to be incorrect and fraudulent. It is unfortunate but true that those who argue for a rearward hit in the President's head, although they concede the Bethesda autopsy to be false in other areas (like the first shot exiting at the throat) assume that in this one area, possibly, the doctors aren't lying "that much", and that possibly the exit wound on the head shown in the artist's drawing does exist.

The double-head-hit theorists thus invoke Bethesda autopsy descriptions of the head to find an exit wound for a rearward entering bullet.

I believe the Parkland Hospital description, only, on this point. I do not accept the Bethesda autopsy.

2) The wounds of the head from information in the Zapruder frames. Having accepted a portion of the Bethesda autopsy which I reject, the double-head-hit theorists then, I believe, buttress their error and find encouragement for this acceptance by making two further errors which are, unfortunately, internally consistent in appearance.

The first is to misinterpret visual data regarding the wounds in the right temporal area in the frames following 313. The second is to misinterpret the meaning of the red blob that appears in 313.

Since both mistakes lead to the same wrong conclusion, the double hit theorists get false confidence that they have a mass of internally consistent evidence which supports their placement of an exit wound on the head, and their double hit theory. (I have

reference to the exit wound for the rearward entering bullet).

The wound in the temporal area as shown in frame 314 and on.

It is my opinion that the Zapruder slide set has been altered. There are obviously gaping wounds of exit at the rear of the President's head, if the Parkland testimony is correct. This whole area ought to be distinctly gray, and a gory sight to see, in the frames following 313. The president's brain's were exposed! Instead, there is an almost wine-red opaque blob that obscures the rear of the President's head in the frames following 313 (and especially in frame 323).

I have shown these frames, in color, to one photographer who agrees that these 35mm slides have been retouched in these, as well as in several other areas. (This would have to have been done by making color prints; altering the color prints, and then rephotographing the altered color prints).

Since most of the critics do not agree with any of this, I think that they are erroneously accepting the Zapruder film as gospel, and misinterpreting this sequence to find wound support for the double hit, thus partially validating the Bethesda autopsy observations.

I do not mean to imply that government CREATED exit wounds on the Zapruder film to match the Bethesda autopsy. I do think that they obliterated EXIT wounds that would have corroborated the Parkland Hospital description.

As far as the right temporal area is concerned, I see nothing but a totally inconclusive blotch. I do not think that what is there warrants arguing that an exit wound exists in this area.

3. The red blob in frame 313. I believe that the blob in 313 is the result of a forward striking bullet impacting at the right temporal area, causing blood and other fluids to exit there, because of the sudden increase in pressure; the fluids and blood are exiting at the entrance orifice created by the bullet.

I do not believe that this shows an exiting bullet. Why didn't the Parkland Doctors see a huge gaping hole in that area if an exit wound is located there?

If you put a hole in a melon (on its left side, and from the left) that is ripe, or in a tomato, and if you then hit the tomato so as to make it go the right, but strike it where the hole is, the tomato will go to the right, but fluids will come out of the whole heading leftwards. This is exactly what I believe the blob in 313 signifies: Fluids exiting from an entrance orifice.

Before going on to point 4, let us examine a published argument made for a double-head-hit in the letters-to-the-editor column of Ramparts Magazine (March 1967). The letter is written by Ray Marcus.

Ramparts Letter-to-Editor

The author splits his analysis of the motion into 3 separate parts:
1) 312-313 (analyzed as downward, forward, and to the right)
2) 313-314 (no motion)
3) 314-315 (and on) (Analyzed as leftward and rearward and upwards).

The author writes: "...it can be seen that President Kennedy's head does not describe a continuous motion, as we would expect to be the case if it was struck by a single bullet. Instead, it describes two separate motions between 312-315: the first in 312-313; forward, down, and towards the right (italics added); the second in 314-315, an arc---up and over (italics added) to the left rear, and against the back seat. These two distinct motions strongly suggest they resulted not from a single shot, but from the impact of two separate bullets."

I strongly disagree with the author.

1) President Kennedy's head does not go "towards the right" between frames 312 and 313. There is absolutely no evidence or argument present to justify this asserted motion, in the letter. It is an unsupported assertion, yet is crucial to the argument.

In several private conversations, the author of the letter claims that he can perceive-and-deduce this rightward motion of the JFK head from blowups of the Zapruder film frames. I do not perceive any such motion. I also claim it is practically impossible, even if JFK's head ware translated a few inches to the right (which would be directly towards Zapruder) for this to be discernable on Zapruder's film.

* This rotation, if it occured, could be explained by a left-rear shot source.

The author also argue's that JFK's head is turned more to his (JFK's) left in 314 than in 313*. This rotation, even if it did occur, would not have any direct bearing on whether the shot came from the front right or the left rear, unless one could clearly ascertain that the sense of the accompanying translational motion was TO THE RIGHT. The way something is observed to rotate can not be used as a substitute for observations regarding its translatory motion. {The latter tells from which direction the force CAME. The former SIMPLY GIVES INFORMATION REGARDING THE ANGLE OF INCIDENCE}

2) Kennedy's head rises above the refesence line after frame 314, as noted in the letter, and stays above the line during frames 315, 316, and 317. So what? This would be totally consistent with a high forward shot, in which JFK's chin, having been thrust down against his chest (312-313) then bounces back off his chest and thus rises again(314-317), and then falls again as the body is driven further backwards. If the whole JFK body can"bounce" off the rear seat of the car, surely there is nothing wrong with the chin "bouncing" off the chest, when the head comes to the end of its rotational motion that was suddenly imparted to it by the force of a high speed bullet.

Clearly, this post-314 motion is consistent with both hypotheses and cannot be used to distinguish between them.

In effect, Kennedy's head "bobs" up and down after 312 (in my opinion) and I think that the most significat aspect of these oscillations is that the initial motion, 312-313, was CLOCKWISE AS VIEWED FROM ZAPRUDER'S POSITION. In more evaluative terms, downward and/or forward.

3) I think that the author of the letter takes the second portion of the bobbing motion (the 314-315-316 which I interpret to be the chin bouncing off the chest) and concludes:

a) the entire motion is not "continuous"

b) there are, in fact, "two separate motions" between 312 and 315.

He concludes that there were two correspondingly separate bullet strikes. These [illegible] motions are only "separate" and the entire sequence "discontinuous" if one ASSUMES that the first shot which struck the head came from the rear. If one understands clearly the mechanism by } IMP

{AND MUST RESULT FROM}

which the 312-313 motion is the direct result of a forward-right-high-angle-shot, there is nothing discontinuous or "separate" about motions in this sequence. (This mechanism was explained in the beginning of the memorandum). To such a person, the double-hit remains an interesting academic possibility, only to be invoked if the medical evidence or any other evidence indicated that, however unlikely it appeared to be, this in fact was the explanation.

5) The most that can be said for the double-head-hit arguments that are based on the motions observed in the Zapruder film frame sequence is that these motions are consistent with two distinct bullet strikes.

A final comment: Double head hit theories were born when various observers first noted that 312-313 motion appeared to be "forward", and these observers had absolutely no idea that such motion was perfectly consistent with it being the rotational motion of a High angle forward shot. For this reason, they insist on talking of discontinuities in the motion, "double arcing", and a host of other terms inspired by the idea that the 312-313 motion comes from a rearward shot, and that the post 313 motion comes from the grassy knoll shooter everyone diligently hunts for but cannot find.

Going back to the Ramparts letter: it is impossible to argue that there were in fact two distinct bullet strikes, unless one buys the crucial phrase that the inital 312-313 motion was not only downward and forward but also: "...and to the right." There is no evidence offered to support this crucial assertion.

The remainder of the Ramparts letter then argues that the Zapruder film shows a "large wound...on the right side of President Kennedy's head...". My opinion on this has been set forth previously.

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4. Photographic data concerning the location of the knoll shooter(s).

In the Spring of 1965, I discovered photos that led me to believe assassins were firing from ground level behind the wall and fence area on the grassy knoll. I distributed these photos to many of the other researchers. I continued my research and concluded, by August of 1965, that camouflage was used in the assassination of President Kennedy, and that the images I had found, though of real people, barely scratched the surface of what was taking place in the area of the grassy knoll.

I concluded that the hedge rows running in front of the low concrete wall, (on the knoll across from Jean Hill) was false. I also concluded that some sort of iron trellising ran from the tree behind the wall on the knoll, over to the tree behind-and-to-the-right of Hudson, and on down to the other trees on the knoll. I advanced the idea that whole trees on the knoll were "false" devices which could house men and equipment, and were designed to replace the ones taken out. I thought that if this was so, the knoll itself would have actually had to have been excavated in order to put in material which would be a proper foundation. I certainly did not understand HOW any of this could have been done, and had no evidence of the construction phase. I did have what I believed to be quite a bit of data that somehow it HAD been done.

Late summer (1966) when I was working for Ramparts in San Francisco, I used the extremely large picture collection of the Chronicle and located several important pictures of trees on Dealey Plaza which further strengthened my conviction that impossible-to-normally-explain landscape changes were occurring overnight in this area.

About two months ago (Jan 1967), I found my first concrete photo evidence that beneath the surface of the knoll were bunker-like structures with men and material in them.

The work I have been doing with camouflage was never meant to be tied in with an analysis of the Zapruder film frames. But I find that will inevitably happen if the double-head hit theory is proved false.

Well before I knew of the subtleties of the 312-313 motion, I had concluded that men must be firing at JFK from an area above the head of Emmet Hudson, and to his left. I came to this conclusion from working at high magnification with color photos of the knoll.

I had told several persons at that time that although I thought men were prepared to fire at JFK from positions concealed by elevated camouflage, I could not say for sure that any shot was in fact from such a location: eg; that any hit was scored by a gun emplaced in such an elevated location, known

When the 312-313 motion was first pointed out to me, I immediately realized its possible significance in the context of the work I was doing with knoll photos re elevated camouflage.

1. Camouflage and its relationship to the Head Snap Sequence

The 312-313 motion means one of two things: either camouflage was used, or the double-head-hit theorists are correct. Here is why.

If there is NO double head hit, then the 312-313 motion (as carefully explained in the beginning of this memorandum) is the tipoff that the forward shot is HIGH ANGLE.

The result, in this case, would be that the 312-313 portion of the Zapruder sequence would strongly support the camouflage theory by showing that the shot came from HIGH and to the front right. There are only "trees" there; and the one that is in fact near Hudson, from the beginning, was the focus of many many color enlargments I have made because it reveals a structural nature that is inconsistent with an ordinary tree, or the tree that appears there in later pictures. This, in fact, is the tree from which smoke or steam was seen coming by Holland and Miller, and from which the shots seemed to came, according to Reilley.

It is important to note that if the double-head-hit theorists are wrong, there is a multiple error involving

a) erroneous physical interpretations of head motion in the Zapruder film frame sequence
b) erroneous medical-physical interpretation of the 313 red blob
c) erroneous visual interpretation of the temporal area shown in the film frames following 313.

Both theories (camouflaged shot source and double-hit) can be correct. But if the double hit theory is false, then camouflage must be correct. Only time will tell.

David S. Lifton